



## PIER Energy System Integration Program Area

### 2 kWhr Flywheel Energy Storage System

**Contract #:** 500-98-036

**Contractor:** Trinity Flywheel Power Corp

**Contract Amount:** \$1,057,406

**Match Amount:** \$1,062,494

**Contractor Project Manager:** Melissa Reading (925) 455-7998

**Commission Contract Manager:** Jamie Patterson (916) 657-4819

**Status:** Completed

#### **Project Description:**

AFS Trinity Power Corporation has completed its PIER contract in February, 2004 for a Flywheel Energy Power System as documented in final report #500-04-014 titled *Flywheel Energy Storage System*. The overall goal of this project was to identify the key performance elements of an advanced flywheel power system that can perform load following for a distributed generation system. The product demonstrated in this contract is a 100 kilowatt (kW) flywheel power system that delivers power for 15 seconds. Prototypes of this system have been constructed, and tested. As a result of this effort, the key performance elements were identified and demonstrated. The demonstrated system shows good commercial potential, and the results of this project are being used by AFS Trinity to continue with additional development work to make the commercial product more responsive to the marketplace. The company is also seeking new equity investment to complete the steps to a full commercial product launch.

During this contract, AFS Trinity also learned much about the commercial application requirements for this product. The project started in 1998 with the goal of producing an energy storage flywheel that could be used with a residential photovoltaic system for load-shifting energy storage. As the project progressed, AFS Trinity and the Commission realized that this market application had a very low probability of commercial success and decided to shift to a more commercially viable application; that of supporting the increased market penetration of distributed generation systems. The project goal was changed to produce a high power, short duration flywheel power system with applications in distributed generation and power management. Development was then completed for this market application. A successful demonstration of the AFS Trinity flywheel technology to support this application was also completed.

#### **Benefits to California:**

The results of the research and demonstrations completed in this project have demonstrated that flywheel power systems can create both economic and environmental benefits for the State of California.

Successfully fielded commercial flywheel technology will reduce business losses from power disturbances and increase industrial energy efficiency.

Environmental benefits include air quality improvements and reductions in solid waste generation. As a battery replacement in distributed utility applications, or in the existing commercial UPS market, flywheel technology can directly eliminate environmentally unfriendly batteries systems from the solid waste stream.

With further testing, development and customer acceptance, the AFS Trinity flywheel power system can successfully complete the transition to a commercial product. It serves as an excellent example of the successful collaboration between government and industry.

**This project supports the PIER Program objectives of:**

- Improving the reliability of California's electricity system by developing a distributed-generation-enabling flywheel energy storage system technology that permits distributed generation technologies to be more easily integrated into the utility grid.
- Reducing environmental risks from California's electric system by providing a more environmentally friendly energy storage technology and enabling the increased use of environmentally responsive renewable distributed generation technologies.

**Proposed Outcomes:**

1. The technological objectives of this project are to:
  - Produce a 2 kWh Flywheel Motor Generator.
  - Use magnetic bearings instead of ceramic bearings.
2. The performance objectives of the flywheel energy storage system are:
  - Usable storage up to 2 kWh.
  - Maximum output power greater than or equal to 5kW.
  - A rated output of 2kW.
3. The economic objective of this project is to:
  - Have a production cost of \$30,000/kWh, or less, for production volumes of one to ten units.

**Actual Outcomes:**

During this effort, AFS Trinity Power has achieved several significant milestones that have advanced the state of flywheel technology and moved closer to a commercially viable flywheel power system. These achievements were:

1. Achieved the following technological objective:
  - Produce a 420 kWh Flywheel.
  - Integration of active magnetic bearings.
2. Achieved the following performance objectives:
  - Highest energy density and power density of any commercially available flywheel power system.
3. Achieved the following economic objective:
  - Extensive market analysis of flywheel commercialization opportunities.
4. Advanced motor control software that exceeds the capabilities of any known third party product.

**Project Status:**

This project is completed.

Final Report Title: Flywheel Energy Storage System

PIER Publication Number: 500-04-014. Please right click on

PIER Web Location: [www.energy.ca.gov/pier/final\\_project\\_reports/500-04-014.html](http://www.energy.ca.gov/pier/final_project_reports/500-04-014.html)

This effort has successfully identified and demonstrated the key performance elements an advanced flywheel power system needs to perform to provide load following for a distributed generation system. As a distributed generation load following device, it will facilitate customer acceptance of fuel cells, microturbines and natural gas combined heat and power systems.

In addition to the distributed generation load following application, AFS Trinity has identified commercialization requirements for three additional applications of its flywheel energy storage systems: power quality, light rail power management and industrial power management. This wider variety of commercial applications identified in this effort will help AFS Trinity and other emerging flywheel

energy storage companies accelerate the commercial acceptance of their products.

Furthermore, AFS Trinity continues to work with several business incubator services in their search for new equity investment that will assist AFS Trinity in launching its flywheel product line. Concurrently with this project, AFS Trinity developed a detailed business plan for the commercialization of this emerging technology.

AFS Trinity recommends the continuation of the product development and market development of this promising technology. The next key technology milestone is to demonstrate the successful operation of the flywheel system at an end user site. AFS Trinity will continue to seek both government agency funding and private investment to achieve that goal.